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Red and green make yellow: An Interactive multimedia tutorial designed to teach the basic concepts of additive and subtractive color

Suzanne Grinnan

School of Printing Management and Sciences
Rochester Institute of Technology
Rochester, New York

Certificate of Approval

Master's Thesis

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Thesis Committee:

Marie Freckleton
Advisor

Marie Freckleton
Graduate Program Coordinator

Red and Green Make Yellow:

An Interactive Multimedia Tutorial Designed to Teach the Basic Concepts of Additive and Subtractive Color

by
Suzanne E. Grinnan

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in the School of Printing Management and Sciences in the College of Graphic Arts and Photography of the Rochester Institute of Technology

May 1992

Thesis Advisor: Associate Professor Marie Freckleton

For information, contact:
Suzanne Grinnan
Conway Road
South Deerfield, MA 01373

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Contents

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Definition of Terms

The following definitions are those of the author and reflect the terminology used primarily, but not exclusively, within the world of electronic imaging and multimedia development.

Authoring System: A scripting software program which allows non-programmers the ability to design/write the content of and to determine the navigation process through an interactive program.

CLUT: Color Look-Up Table. Contains the 256 colors found in an 8-bit image.

8-bit color: Allows for a 256 color palette.

Hue: .The dominant wavelength of a color.

Image Manipulation Programs: Software programs which allow images to be manipulated. Some examples of manipulation include tone correction, combining images, applying filters and converting color spaces.

Interactive: A user's ability to control certain aspects of a computer tutorial.

Multimedia: The incorporation, through an authoring system, of various formats of media, such as audio, video, animation, graphics, and images.

PICT: A Macintosh format of storing digital data which allows it to be imported into various software programs.

Saturation: Also known as **Chroma**. The purity or intensity of a color. May also be described as the amount of gray present in the color.

Scanned Images: Reflection or transmission copy which is converted to digital form through the use of a scanning device. In digital form, these images may be altered by utilizing image manipulation programs.

24-bit color: 8-bits per pixel each for R, G, and B. Allows for a 16.7 million color palette.

Value: Also known as **Lightness**. The lightness or darkness of a color determined by how much light it reflects back to the eye.

Abstract

> As a graphic designer, it is your job to know how to visualize and describe color accurately, as well as to understand what can be reproduced in print and why.[1]
>
> Anyone who reflects about color is always in danger of assigning an independence to it that it does not have. Ernst Junger once compared vowels with colors . . . . Vowels give a word its emotional tone; however, it is fundamentally their combination with consonants that makes out of them a work that has meaning. In exactly the same way, color gives the work of art its character and mood; but it needs attachment to a form in order to communicate anything with meaning.[2]

The division between designers and printers is becoming increasingly blurred as the capabilities of the desktop environment improve. Electronic imaging is one area where this disintegration is rapidly occurring. Abilities that were formerly the domain of the color separator, image assembler, and printer, such as scanning, color correction, and film separation, are available through many popular software programs. Unfortunately, the education required to allow the proper application of these software options is not as accessible as the tools themselves.

Both printers and graphic designers will have to educate themselves about the emerging and changing technologies of the other. Eventually a common language will develop to facilitate the smooth production of designs created on the desktop. It is vital to the industry that students of design learn the terminology and technology of the printer, and that students of printing learn the terminology and technology of the designer. Educational institutes are one logical place for this process to begin.

The purpose of this project was to develop a teaching tool addressing this need. The area of color was chosen as a focus because it is one of the areas where terminology

and past learning experiences may conflict. A solid understanding of color is also becoming increasingly important as "desktop" systems operators prepare graphic designs directly for imagesetting. Interactive multimedia was determined to be the appropriate format for such a project and the subject matter was further defined. The result is a tutorial, created for beginning graphic and printing design students, which teaches the basic concepts of additive and subtractive color.

Introduction

Purpose of the Study

The purpose of this study was to develop an interactive multimedia tutorial to teach the basic concepts of additive and subtractive color to students in beginning design classes. It was created under the premise that the user would be familiar with basic Macintosh operations, such as opening a program, clicking, and dragging.

Red & Green make Yellow was created as the first of a series of tutorials which would deal with color. The module is not meant to be definitive nor to take the place of courses or lectures which discuss color theory. It is also not meant to be a replacement for a textbook. Rather, this tutorial is meant to enhance the learning of color by providing an additional exercise and experience.

As the subject of color is quite complex, the scope of the project needed to be narrowed and defined. It was decided that this tutorial would focus on some very specific issues, namely the definitions of hue, saturation, and value, and the mixing of the additive and subtractive primaries.

Background of the Study

In 1989, Seybold Publications "introduced the term 'fourth wave' in the printing industry, as a description of the new information technology entering the prepress area .... The fourth wave is described as the transition from dedicated, specialized systems to solutions based on mainstream computer technology."[3] This transition is occurring more rapidly as the capabilities of the desktop environment and its link to traditional prepress systems, such as imagesetters and high end scanners, improves.

While the graphic design and photography industries are anxious to embrace these new tools, some sectors of the printing industry are not. This free access environ-

ment is new to the printing industry, for, "[f]rom being a specialized industry based on dedicated, specialized technology [the printing industry is entering] a world of module-based solutions, where compatibility is a key issue."[4] As equally important as the compatibility of the technology is the ability of designers and printers to communicate effectively.

> Historically there has been, and there still exists, a combatant relationship between designers and printers. This seemingly insurmountable rift is due to a lack of information, common vocabulary, and most of all, empathy. Hopefully, the computerization of the graphic arts industry will bring the printer and designer together in new relationship[sic]; one that is based on cooperation, trust, and respect for each others roles in the process. Printers can no longer afford to be exclusive about their trade. They must be willing to share their knowledge with designers. . . . [Designers] must understand and appreciate the finer, more complex aspects of printing. A new breed of designers must be educated, with the help of their printers, as these two fields merge and functions overlap.[5]

The key to solving "combatant relationships" is education; the education of both designers and printers. The ultimate goal of this project, then, is to aid in that education process.

The Design of the Project

The Scope

This interactive tutorial has been created to help designers understand the basics of additive and subtractive color. It begins by discussing the emotional impact of color in a design, and then addresses the question: "What is color?" *Red & Green make Yellow* uses the Munsell color model to define the terminology of color and concludes with an extensive exploration of additive and subtractive colors and their uses.

The Audience

Much of the information which the printer has is highly technical in format and is described in ways which are intimidating to those who are visually oriented. *Red & Green make Yellow* was created to appeal to those who are overwhelmed by the mere presence of numbers and equations. As such it contains no grids, or equations, and only a few appropriate graphs. Instead it employs a creative and visual approach.

This tutorial was designed for beginners in the graphic arts, primarily graphic and printing design students. It may also be used by others who would like to increase their proficiency in and vocabulary of color.

The Format

Interactive multimedia was determined to be the most appropriate format for this project, primarily because it encourages user participation and supports visual approaches to learning.

Philosophy Behind the Decision

Interactive multimedia programs are becoming increasingly available as development

software improves and as computers become more accessible. When developing a program, one must consider the purpose of utilizing computers to teach. Are they meant to replace a teacher, a lecture, or a textbook? Or are they meant to provide a new type of educational tool? Those which are designed to replace a teacher or lecture are in danger of becoming too text heavy and of taking on the appearance of a computerized textbook.

Along with this emergence of programs has come a "canned" format, somewhat dictated by the software used to create the programs and somewhat dictated by the developers who have become comfortable with a certain "look". Many programs rely on the format of the book, complete with a table of contents (this usually appears as a series of buttons which, when clicked on, will bring the user to a specific section of the program), chapters, and indexes.The danger of this is that when formats become too familiar, users may not absorbed the content. Since it is likely that the process of clicking through interactive tutorials will be come very automatic as these tools are utilized more by industry and schools, developers need to consider the visual impact of the application. The goal is to excite the audience so that they learn what is being conveyed, not to simply have them click through a program.

Red & Green make Yellow addresses these issues of content and program design by challenging the norms which are emerging in multimedia development. Firstly, *Red & Green make Yellow* was designed to rely more on visual presentation than on text and secondly, *Red & Green make Yellow* was designed as a linear versus hierarchical, "chapter-structured" program. As stated above, emphasis was placed on conveying concepts visually in order to encourage the user to really look at the program and thereby absorb the material. Ideally the user will walk away from *Red & Green make Yellow* with a mental image which may be recalled more easily than a written definition. To facilitate this goal, as well as to provide the tutorial with cohesion, an ocean theme was chosen for the program.

What is interactive multimedia

Interactive multimedia is defined as a technology which "links together multiple collections of information under the hierarchy of a single application or program." This information may be in the form of graphics, animation, video, photography or sound. "What distinguishes multimedia from film or video is interactivity. . . . Computer-based multimedia allows the user to determine the pace and path through ever-branching options."[6] Thus the program should be easy to navigate.

Why multimedia

As stated above, interactive multimedia is primarily designed to allow the user to determine the pace of execution through working one-on-one with the tutorial. Thus, it is an ideal teaching tool. *Red & Green make Yellow* is concerned with color, ultimately in relation to desktop systems and final output. This, combined with the intimacy of use and the fact that many of these designers will be learning the tools of the computer, makes the computer the logical teaching platform for this tutorial.

Reason for Interest

Prior to enrolling in the graduate program, I visualized myself ultimately positioned as a liaison between the designer and the printer. While the technical aspects of printing fascinate me, my love lies in the creation of the visual. My focus during the past year has been electronic imaging and publishing. My personal artistic focus concerns color and texture. When I was learning additive and subtractive color theory I had difficulty because it conflicted with how and what I had learned as an artist. I believe that there are others, especially those visually oriented, who have and who will encounter this confusion. I feel that this project was a perfect marriage between my personal interests, career goals, and

the knowledge which I have accumulated while at RIT. Technically, this project provided me with a method for refining and combining many of my acquired desktop skills, such as image manipulation and graphics generation, as well as provided me with the opportunity to explore the skills associated with multimedia programming and development.

Procedure

Methodology

Red & Green make Yellow was implemented using SuperCard 1.6. Most of the images were created in PhotoShop 2.0. Text and simple graphics were generated in SuperCard. Sound was captured using the MacRecorder system and Sound Edit 2.05. Photographic images and illustration elements were brought into the Macintosh system via the Agfa Focus A Color Plus flatbed scanner and the Nikon 3500 Slide scanner. When utilizing the Agfa scanner, images were scanned at 240 dpi and then color corrected and manipulated in Photoshop. Images scanned using the Nikon 3500 were scanned at 1:6 and then resized and saved in the PhotoShop format. All images were saved at 72 dpi, the resolution of the computer screen.

The tutorial was divided into sections based on the concepts being communicated. These sections later became very important when importing all of the images to SuperCard. Photoshop was used to create the composite images used in the tutorial. Once all of the images and elements to be used in one section of the tutorial were completed, the individual files were copied and pasted into one large PhotoShop file. This file was then converted to Indexed Color, Adaptive/Diffusion option and saved. Each element/image was then cropped from the Indexed file and saved in the PICT File format, 8-bits/pixel, for importation into SuperCard. The indexed color adaptive/diffusion option creates a CLUT (Color Look-Up Table) for the images within the file. The CLUT is a 16 x 16 grid which contains the 256 colors which can be used to make up an 8-bit image.

One of the present drawbacks of desktop multimedia is the large amount of space required for storage. In order to save space, which allows the authoring programs to run faster, images are reduced to 8-bit color, for a total of 256 colors. The drawback to

this is that multiple images do not always conform to the same 256 colors. CLUTs may be imported to SuperCard along with their image but a problem arises when going from card to card in SuperCard. If consecutive images do not have the same CLUT, the CLUT needs to be changed with the image and this causes the screen to flash different colors. This flashing is disturbing to and hard on the human eye.

Since this program dealt with color, the integrity of the original images was important as was the ability to produce a wide range of colors. In order to compensate for the screen flashing, all of the images of a particular section were placed in the same Photoshop file and used to generate a common CLUT (the indexed color and adaptive/ diffusion conversion described above). A black screen was placed between each of the sections of the tutorial. This allows SuperCard to change the CLUTs for each section without generating the characteristic flash.

Red & Green make Yellow is an 8MB file and is stored on a 44MB removable cartridge. A brochure and matching cartridge cover wrap-around were designed to accompany the tutorial.

Equipment

The following equipment and software were used to produce *Red & Green make Yellow* :

Macintosh IIsi, system 7.0 with 9MB RAM and a 40MB harddrive
Macintosh IIx, system 7.0 with 12MB RAM and a 120MB harddrive
44MB cartridges and a removable harddrive
Nikon 3500 slide scanner with PhotoShop plug-in
Agfa Focus A Color Plus flatbed scanner with MacView
MacRecorder
PhotoShop 2.0
SuperCard 1.6
Sound Edit 2.05

Results of the Project

A survey, which may be found in Appendix B, was administered to seven design students in the School of Printing Management and Science who completed *Red & Green make Yellow*. The goal of the survey was to determine if the program's design was successful. Namely, if the program was accessible to most students in terms of content, level of vocabulary, and level of technical information; if the program was visually appealing and held the user's interest; and if the exercises were beneficial. The results are as follows:

User Response to the Project

1. Background of User: *All of the users tested were enrolled in a design or beginning printing class at RIT. They ranged from a photography student taking his first design class to a press operator.*

2. Previous Knowledge of Color: *Three of the users responded by saying that they knew quite a lot about additive and subtractive color. The same number knew very little about color, and one felt they were "middle of the road" in their knowledge.*

3. Need for this Knowledge in Present Job: *The answers for this were split, most likely because of the wording of the question. The survey was designed to be administered to beginning design students from a night school class who were enrolled in a printing certificate program. Due to time considerations, the survey was administered to students chosen during day time hours. Most of these students do not have jobs in the printing industry; some, however, realized that through their school work they deal with these concepts.*

4. Problems with the Program: *There were no real problems encountered with the program. Two of the users remarked that the screens changed too slowly, or that they were frustrated by how fast the objects on the screen could be dragged. Another stated that one of the screens at the beginning went by too quickly for him to read it. Steps were taken to rectify the latter concern. Unfortunately the former concerns are primarily dependent upon the computer on which the program is being run.*

5. Overall Rating:
Responses as follows:
fantastic: **4** very good: **3** good: just ok: not so great:

6. Instructions Easy to Understand:
Responses as follows: yes: **7** no:
comments: *Two people commented that the directions for the saturation/value exercise were not very clear. Their advice was taken and these directions were changed.*

7. Value/Saturation Exercise:
Responses as follows:
valuable: **5** just ok: **1** not very helpful:
-one user did not respond
comments: *This seemed to be a favorite part of the program for many of the participants. They were very pleased when they got a perfect score; one was disappointed that the computer did not cheer when this happened.*

8. Printing Simulation Exercise:
Responses as follows:
valuable: **7** just ok: not very helpful:

9. Understanding of Color Post-Tutorial:
Responses as follows:
better: **4** the same: **3** worse:

10. Visual Assessment: *The comments were as follows: "Great theme"; "Very good. They are a good artistic bridge between the technical and the artistic"; "I loved the visuals. They were an excellent choice for this program"; "They were great"; "Excellent - Very creative"; "Excellent! Terrific and very easy to understand. Visuals definitely make the difference when learning new material"; and "I think they are good - impressive program."*

11. Amount of Text:
Responses as follows:
too much: **1** *("just a little")* just right: **6** too little:

12. Level of Text (vocabulary, etc.):
Responses as follows:
too easy: just right: 7 too difficult:

13. Features of the Program that were especially liked:

"The visual aids. The direction taken to understand additive and subtractive color. Everything!!!"

"Ingenuity & Creativeness"

"The use of the water as a theme. The interaction with the computer. Seating the fish at their seats."

"The visuals. Easy to understand. Made me realize that there is alot [sic] that goes into color."

"I really liked the way the program was set up. It takes you step by step into understanding RGB as additive colors. The visuals especially helped in seeing how RGB make white. Everything was perfect."

"Playing with mixing the colors."

"Use of sound"

14. Features of the Program that were not liked:

"Nothing. This was better than reading from a book."

"Slow movement of the fish objects."

"Would like to have more sound. ."

15. Suggestions for Changes:

"More interaction at the beginning with the viewer."

"Maybe read aloud the program. Some of the type faces weren't very 'special'."

"Faster, if possible - however for someone in a learning situation and unfamiliar with computers it is not too slow."

"I wouldn't change the program. It couldn't have been done better."

16. Recommendation to Others:

Responses as follows: yes: **7** no:

Additional Comments:

"I can't say anything but good things. The program was very interesting and well worth the time it takes to go through it. It was a pleasure participating in this exercise. Anyone who doesn't understand additive colors would easily learn about it using this program. Overall, it's excellent."

"Thought it was very informative. Wasn't too technical. The visuals helped alot by letting your eye see the different colors."

"I am truly impressed with your ability in putting together such an intense project. And the ease and information contained within the program. It will be helpful to others."

Evaluation of Responses

As stated earlier, the goal of the survey was to determine if the program was accessible to most students in terms of content, level of vocabulary, and level of technical information; if the program was visually appealing and held the user's interest; and if the exercises were beneficial. From the responses of the users' survey, it may be concluded that the goals of the project were achieved. Nearly everyone responded that the amount of text and level of vocabulary was "just right", thereby making it accessible to most beginning design students. Since no respondent felt that they understood color worse than they did prior to running the tutorial, it is likely that the terminology used and technical information introduced were not confusing. The users were unanimous in their enjoyment of the visual images; the ocean theme seems to have accomplished its function, namely of holding the viewer's attention while teaching the basics of color. All of the user's felt that the printing exercise was valuable, while most designated the saturation/value exercise as such. It should be noted that the one respondent who thought the latter exercise was "just okay" did not follow the instructions and revealed the answers prior to solving the problem. The instructions were changed in order to keep this exercise from being confusing to others.

Two areas where the program could be improved are sound and speed. The number of sound effects could have been increased, however as sound uses large amounts of memory, a decision was made to limit its use. Presently, sound occupies approximately 1MB, or 1/8th of the total program. While sounds can be imported once and accessed many times, thereby increasing the amount of sound in a program, repetition may become annoying.

Speed is a function of program size and of individual computer characteristics. Frustration was encountered when dragging the fish in the exercises across the screen.

Dragging was not a problem on the two systems on which it was developed; it was quite slow on the computer on which it was tested. Unfortunately, harddrive variables cannot be controlled by developers of interactive multimedia.

Conclusion

Value of the Project

As the goal of this project was to design an interactive tutorial to teach the basic concepts of additive and subtractive color, one way to measure its value is to compare the user's pre-tutorial versus post-tutorial evaluation of their knowledge of color. When asked how much they presently knew about additive and subtractive color, three of the users responded by saying that they knew quite a lot about additive and subtractive color. The same number knew very little about color, and one felt they were "middle of the road" in their knowledge. When asked whether the program increased, decreased, or did not change their knowledge, two of the users who said that they knew a lot about color and the users who was "middle of the road" felt their knowledge had remained the same, while all of the others, including one who felt that they already knew a lot, said that their knowledge improved. This indicates that *Red & Green make Yellow* was a worthwhile project and that it does what it set out to do, namely teach additive and subtractive color. The technical growth experienced by the developer rates the project as a success on the personal level as well.

Recommendations

As stated in the Introduction, this program was designed as the first of a series of tutorials addressing various aspects of color and color theory. A series could be developed, either around the ocean theme, or a broader theme such as nature, which discusses either aspects of color not covered in this tutorial, such as color psychology, or delves further into some of the subjects introduced in *Red & Green make Yellow*, such as color perception. The series could be expanded to include other areas of graphic design and/or printing technology.

Ideally, interactive multimedia technology will improve so that program development and design will not be constrained by considerations of memory size. For instance, it would have been nice to have included more sound in *Red & Green make Yellow*, but that desire had to be balanced against the fear of creating a tutorial larger in size than the program could handle. Advances in CD-ROM and other technologies will hopefully, in the near future, make these considerations and problems of the past.

Endnotes

[1] Eckstein, Helen. "Understanding Basic Color Concepts", Step-by-Step Graphics Designer's Guide to Color, vol.7, #2, March/April 1991: p.62

[2] Renner, Paul. Color Order and Harmony. (Reinholdt Publishing Corp., New York: 1964).p. 7.

[3] Ertesvag, Ann-Elise. "Production is Dead!" The Evolution of a Revolution. (Trends in Printing, Rochester Institute of Technology: 1990) p. 10-11.

[4] Ibid, p. 10.

[5] Tinney, Brooke Merrill. "Design and Print Coalesce at the Desktop." The Evolution of a Revolution. (Trends in Printing, Rochester Institute of Technology: 1990) p. 15.

[6] Stefanac, Suzanne and Liza Weiman. "Multimedia is it Real?" MacWorld, April 1990, p. 117.

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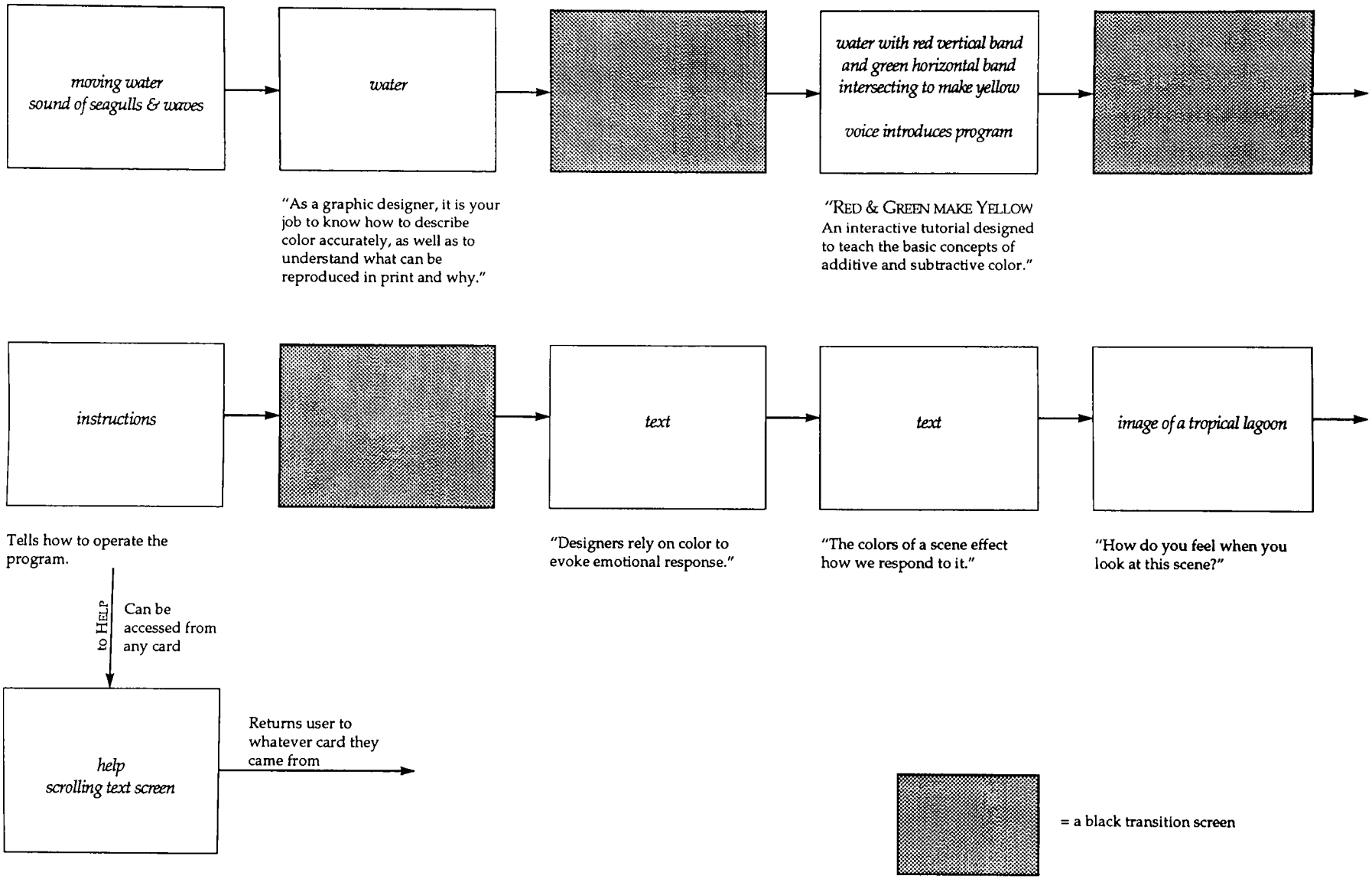
Tinney, Brooke Merrill. "Design and Print Coalesce at the Desktop." The Evolution of a Revolution. (Trends in Printing, Rochester Institute of Technology: 1990) pp. 13-15.

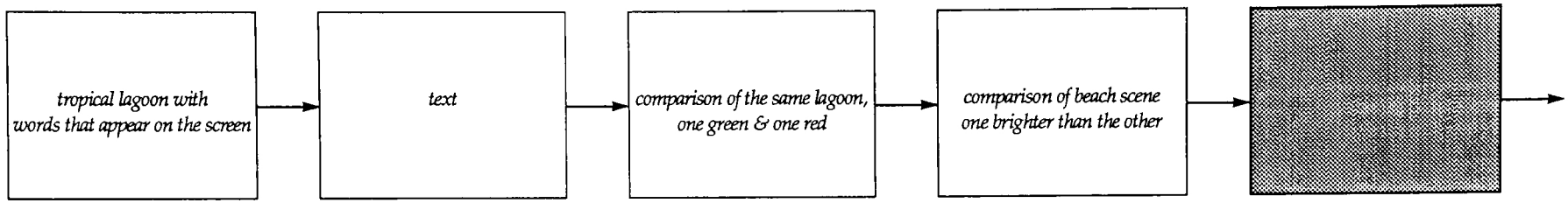
Yeung, Shan M. "The Beauty of Multimedia". Rochester Institute of Technology, June 1991.

Appendices

Appendix A

The following pages contain the storyboard for the tutorial, *Red & Green make Yellow*.


moving water
sound of seagulls & waves
water
water with red vertical band and green horizontal band intersecting to make yellow
voice introduces program
"As a graphic designer, it is your job to know how to describe color accurately, as well as to understand what can be reproduced in print and why."
"RED & GREEN MAKE YELLOW
An interactive tutorial designed to teach the basic concepts of additive and subtractive color."
instructions
text
text
image of a tropical lagoon
Tells how to operate the program.
"Designers rely on color to evoke emotional response."
"The colors of a scene effect how we respond to it."
"How do you feel when you look at this scene?"
to HELP
Can be accessed from any card
help
scrolling text screen
Returns user to whatever card they came from
Contains simple help and program requirements.
= a black transition screen

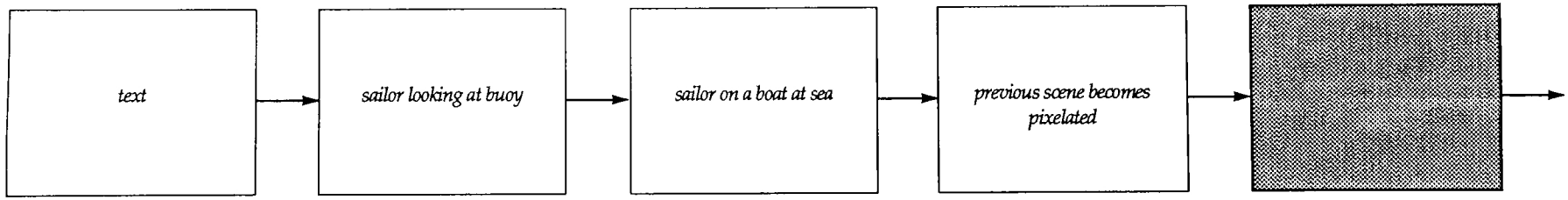


"Do you feel it is . . .
Exotic
Enticing
Mysterious"

"When the colors of a scene are changed, our response to them is affected."

"By changing the greens to reds, the lagoon goes from wet and lush to dry and burnt."

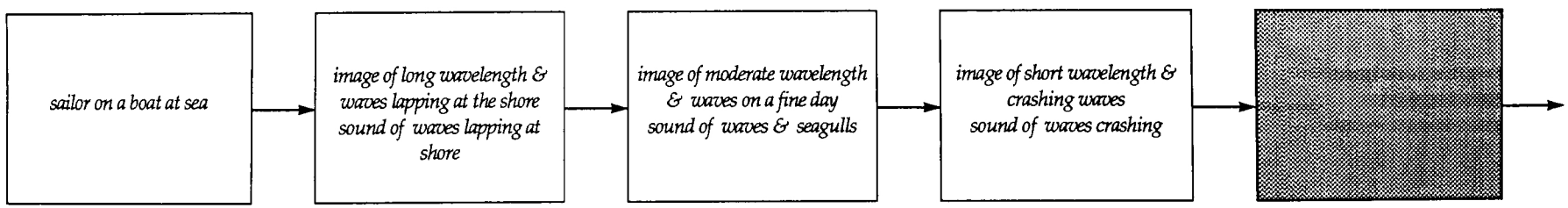
"By changing the bright blues to gray blues, a sunny day becomes a cloudy day."



"Color is simply a wavelength."

"When light strikes an object, the properties of the object cause certain wavelengths to form and travel to our eyes. Receptors in our eyes stimulate the brain to 'see' color."

"The eye can distinguish millions of colors."

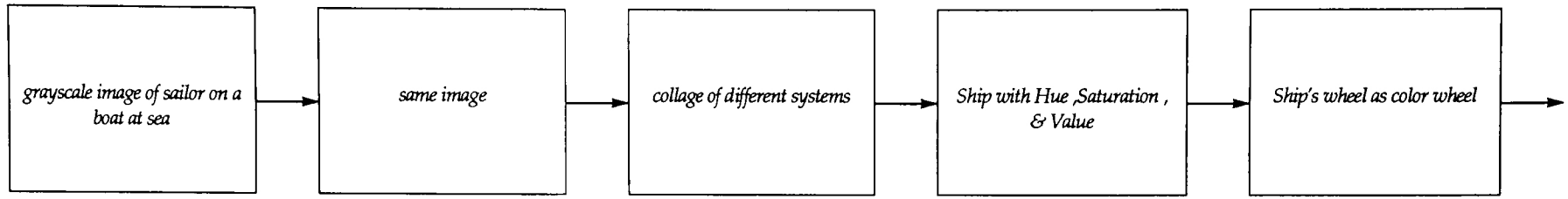


"If you could see color waves travelling, they might look like the waves of an ocean."

"Red would look like a calm ocean, because its wavelength is long."

"Green would look like an ocean on a clear day, because its wavelength is average."

"Blue would look like a stormy ocean, because its wavelength is short."



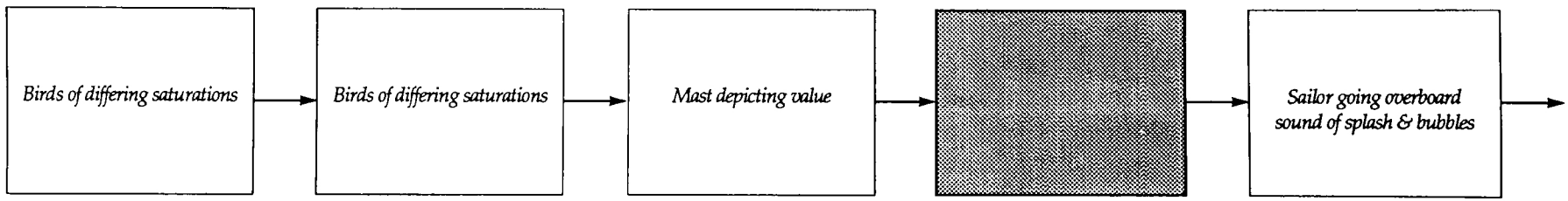
"Just as wind is the catalyst which sends ocean waves travelling, white light is the catalyst which sends color waves travelling.When white light hits an object, some wavelengths are reflected off the object while others are absorbed."

"The wavelengths travel to the eye where the eye's receptors stimulate the brain to see the object. How do we describe the colors we see?"

"There are many systems for describing color, such as the Munsell system, the Pantone Matching System, and CIE Chromaticity Coordinates."

"The Munsell system defines color by Hue, Saturation, and Value."

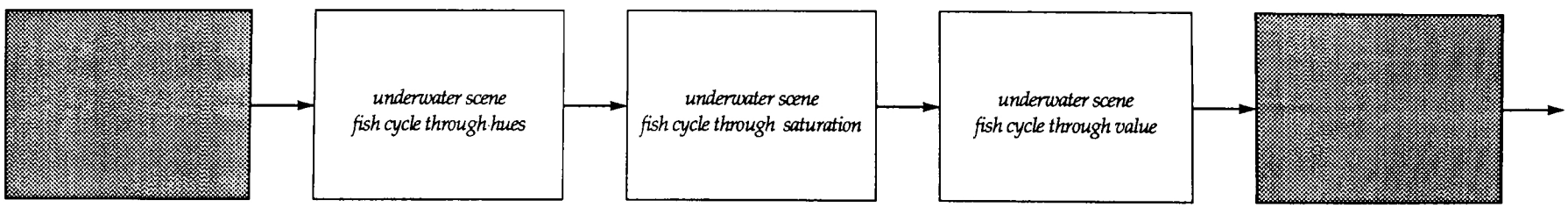
"Hue is the dominant wavelength of the color. We call these colors by their familiar names - red, orange, yellow, green , blue, and purple."



"Saturation is the purity of the color. A saturated color contains no graying factor. If complementary colors are mixed, they make gray."

"Therefore, when the complement of a color is added to it, the color becomes unsaturated. Saturation is measured horizontally."

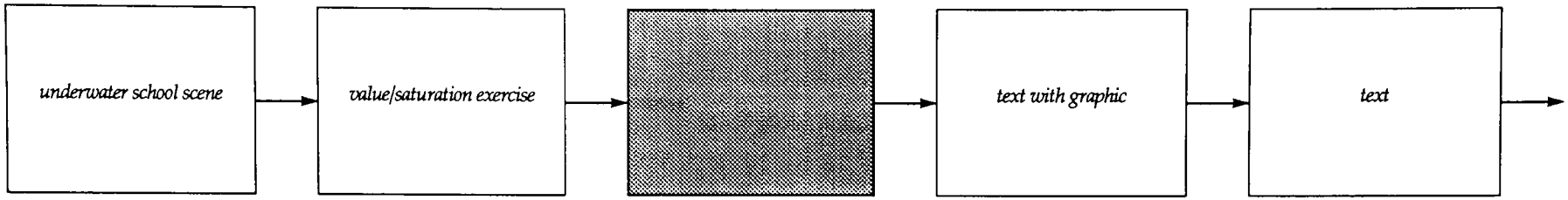
"Value is the lightness of a color. It is measured vertically."



"To review, Hue is the dominant wavelength of the color."

"Saturation is the purity of the color."

"Value is the lightness of the color."

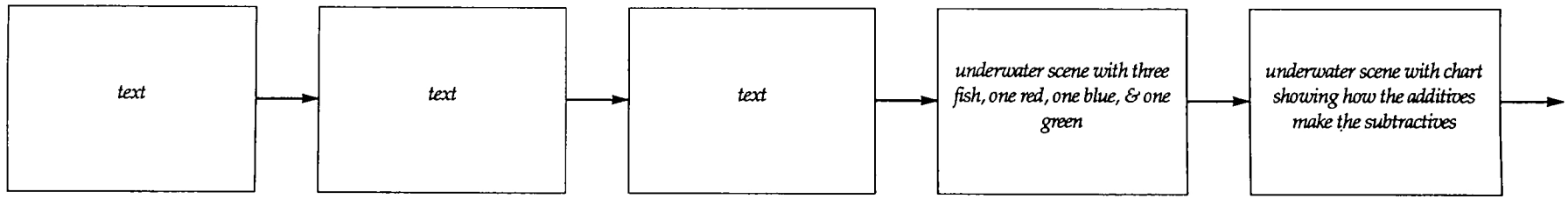


"On the first day of school, Ms. Dolphin decides to arrange her class according to saturation and value. Can you help her? Click on a student and drag her to her appropriate desk."

"When you have finished, click on the treasure chest to see how well you have done."

"Remember, color is a wavelength of light."

"The primary colors of white light are red, green, and blue."



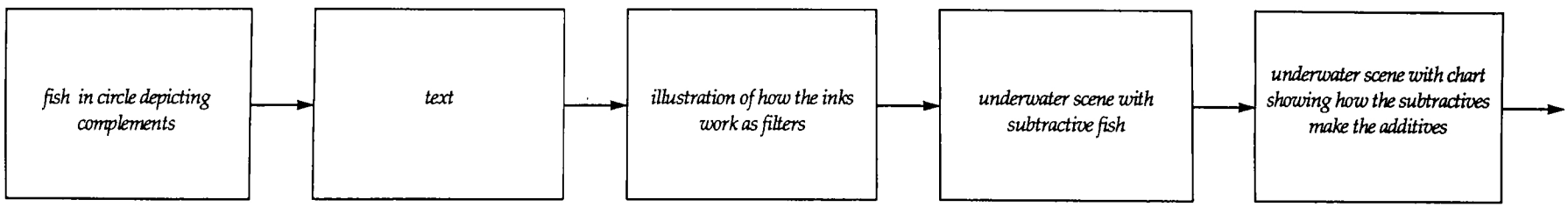
"They are called the Additive Primaries because when added together, in varying amounts, they produce all of the colors which we see."

"These primary colors of white light are called the additive primaries. They are not the same as the pigment primaries (red, yellow, & blue) which we learn about in art class."

"Television screens and computer monitors use the additive primaries to display images."

"To discover what happens when the additive primaries are mixed together, move the fish on top of each other."

"So, Red + Green = Yellow,
Blue + Red = Magenta, and
Green + Blue = Cyan."



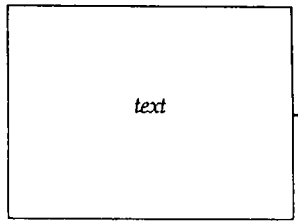
"Cyan, Magenta and Yellow are the complements of Red, Green, and Blue."

"Yellow, Magenta, & Cyan are called the subtractive primaries and are used in the printing process. They are called the subtractive primaries because when they are mixed together, they subtract all of the colors of light."

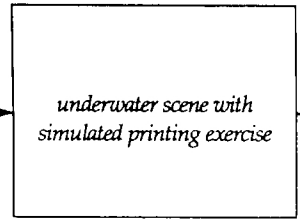
"The subtractive primaries act as filters, absorbing the light of their compliment and allowing the paper to reflect the other wavelengths."

"To discover what happens when the subtractive primaries are mixed, move the fish on top of each other."

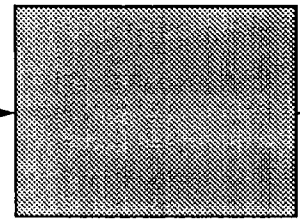
"So, Magenta + Yellow = Red,
Magenta + Cyan = Blue,
and Cyan + Yellow = Green."



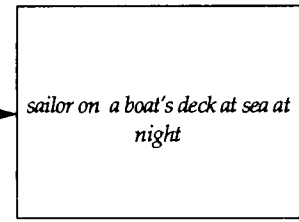
"When we look at a book or magazine under magnification, we discover that all of the images are made up of yellow, magenta, cyan and black dots. Although theoretically y + c + m = black,in reality they only equal brown. Thus black ink is used in order to produce a true black."



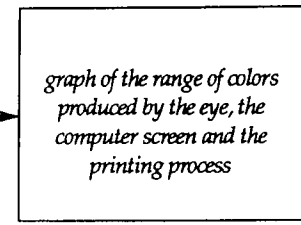
"To discover how this process works, click on the yellow, magenta, cyan, and black buttons. You may click them on and off to see how the different colors interact."



(sound of bubbles rising and a person emerging from the water)



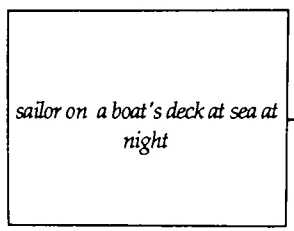
"As was said before, the eye can distinguish millions of colors."



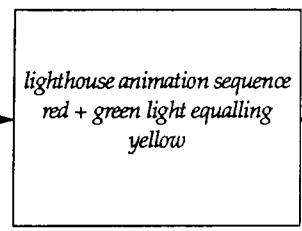
"Unfortunately, the computer monitor cannot depict all of these colors which the eye can see, and the printing process produces even fewer colors than the monitor.

These facts must be taken into consideration when designing with computer color.

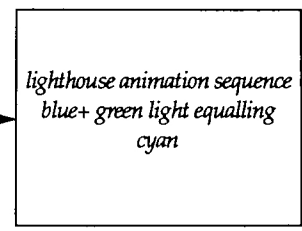
One must also understand how computer converts the RGB color of the monitor to the YMCK color used in printing."



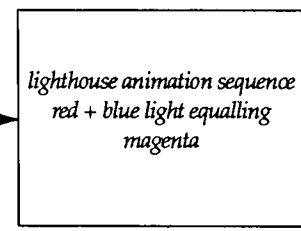
"As a designer, it is important to understand these limitations, as well as to understand how the human eye sees color and how the human brain emotionally responds to color."



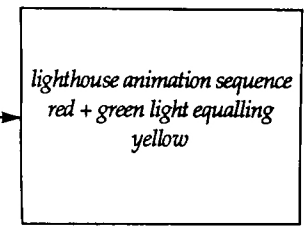
"RED & GREEN MAKE YELLOW"



Information on production



Thank you



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Appendix B

Survey for

RED & GREEN MAKE YELLOW

Before you begin the program, please answer the following questions. Your answers will be kept in the strictest of confidence. Please feel free to be honest.

1. What is your graphic arts background? For instance, are you a designer, a copy editor, a photographer, someone new to graphic arts . . .

2. How much do you know about additive and subtractive color? For instance, nothing, have had one lecture about it, know quite a lot. . .

3. Do you deal with additive and subtractive color in your present job?
If yes, how?

Please run the program now. After you have finished, please fill out the remaining questions.

4. If you encountered any problems while running the program, please list them below.

5. How would you rate this program overall?
fantastic very good good just ok not so great

6. Did you understand the instructions? yes no
If no, what was confusing?

7. Was the value/saturation exercise (placing the fish at their desks)?
valuable just ok not very helpful

8. Was the printing simulation exercise?
valuable just ok not very helpful

9. Do you feel that you understand additive and subtractive color . . .?
better the same worse

10. What do you think about the visuals?

11. Was the amount of test?
too much just right too little

12. Was the text _____ to understand?
too easy just right too difficult

13. What did you especially like about the program?

14. What did you dislike about the program?

15. How would you change the program?

16. Would you recommend this program to someone learning about additive and subtractive color? yes no

Please provide any additional comments below. Thank you for your time.